

Anatomy of the lower limb

Front of the thigh

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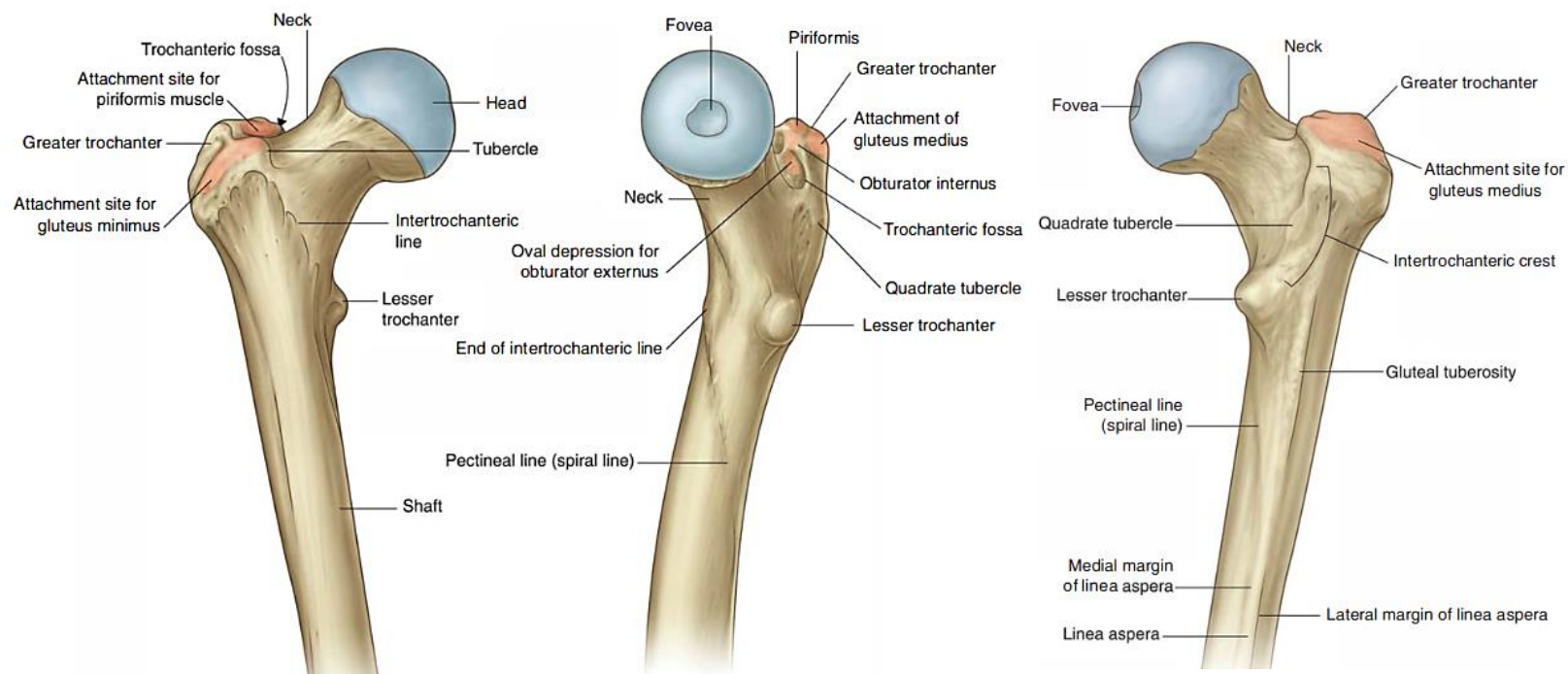
The thigh is the part of the lower limb between the hip and knee joints. For descriptive purposes, the thigh is divided into three regions—front of the thigh, medial side of the thigh, and back of the thigh. The front of the thigh corresponds to the back of arm.

Bones of the leg

The femur is the longest bone in the body accounting for about 1/4th of the body height. It articulates with the hip superiorly at the hip joint and with the tibia and patella inferiorly at the knee joint.

The proximal end

This is represented by the head, neck & trochanter. The head represents 2/3rd of a sphere and is directed medially and anterosuperiorly. It is lodged in the acetabular fossa and has a small pit at its summit; the **fovea capitis**; that marks the entrance of a small nutrient artery and the attachment of a short ligament from the non-articular depth of the acetabulum. The **neck** is slender and relatively long. It is attached obliquely with the shaft making an angle of 125°. It is ridged longitudinally by bundles of fibers; **retinacula**; from the fibrous capsule of the hip joint transmitting many small blood vessels and creating many small **nutrient foramina**. The **greater trochanter** limits the neck laterally and extends anteriorly and posteriorly. The medial surface of the trochanter is concaved by the **trochanteric fossa**. The **lesser trochanter** projects posteromedially from the junction of the neck with the shaft. The **pectineal line** descends for a short distance downwards on the posterior surface of the upper part of the shaft from the lesser trochanter. The two trochanters are joined anteriorly by the **intertrochanteric line** that marks the attachment of the iliofemoral ligament. Posteriorly, the trochanters are joined by the **intertrochanteric crest**. On this crest lies a small elevation for the insertion of quadratus femoris muscle called the **quadrate tubercle**.

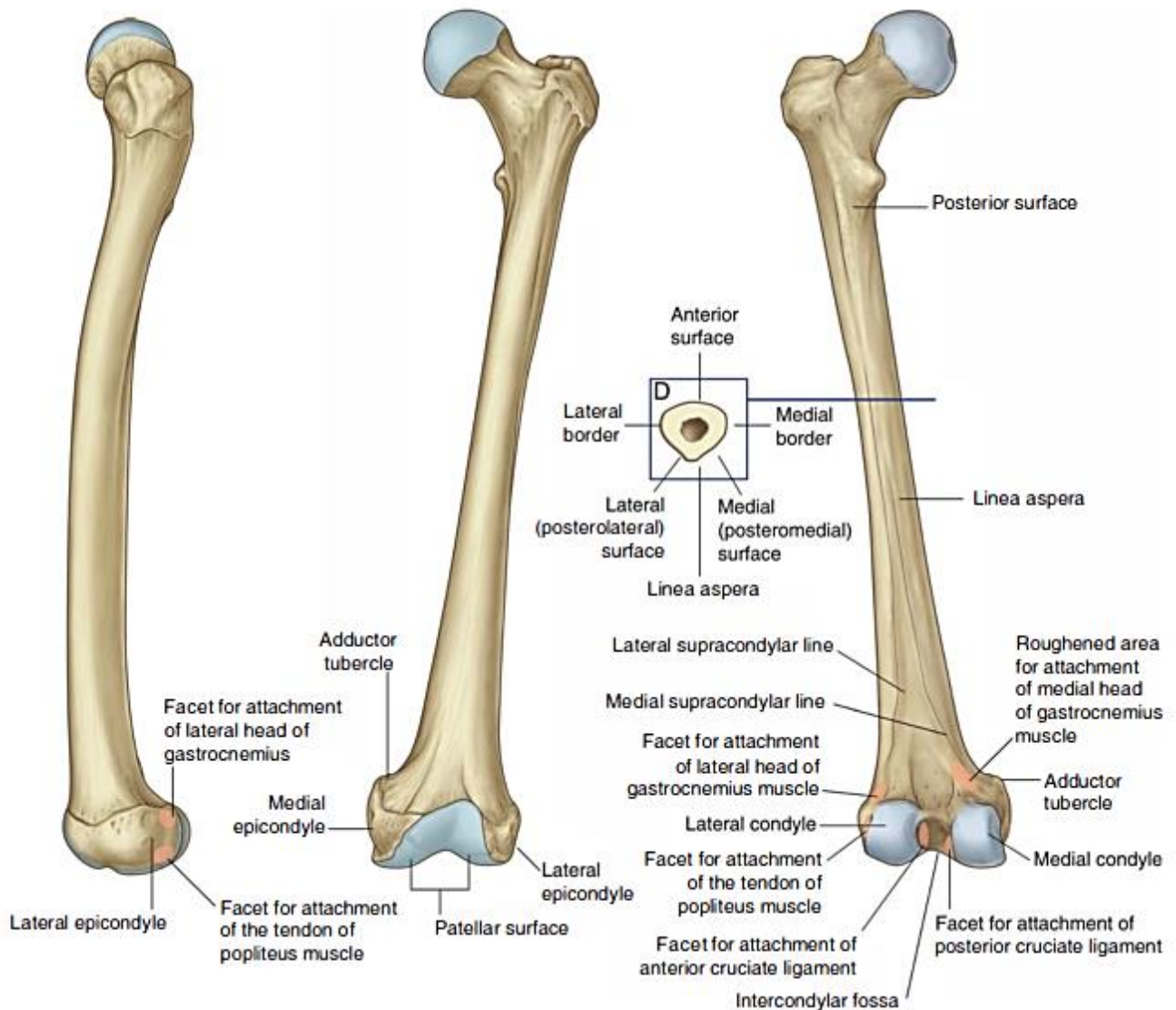


The shaft

The shaft of the femur is **round**; i.e. circular in cross section; and is **convex anteriorly**. The surface is smooth throughout except posteriorly where the **linea aspera** extends longitudinally as a sharp long ridge giving attachments to muscles and to the intermuscular septa of the thigh. The linea aspera has two lips which diverge superiorly and inferiorly. Superiorly, the 2 lips diverge on each side of the pectineal line where the medial lip continues as the **spiral line** that passes anteromedially towards the intertrochanteric line, and the lateral lip continues posterolaterally to the **gluteal tuberosity**. Inferiorly, the two lips diverge and continue as the **medial and lateral supracondylar ridges or lines**. These 2 supracondylar lines mark the lower part of the posterior surface of the femur called the **popliteal surface**.

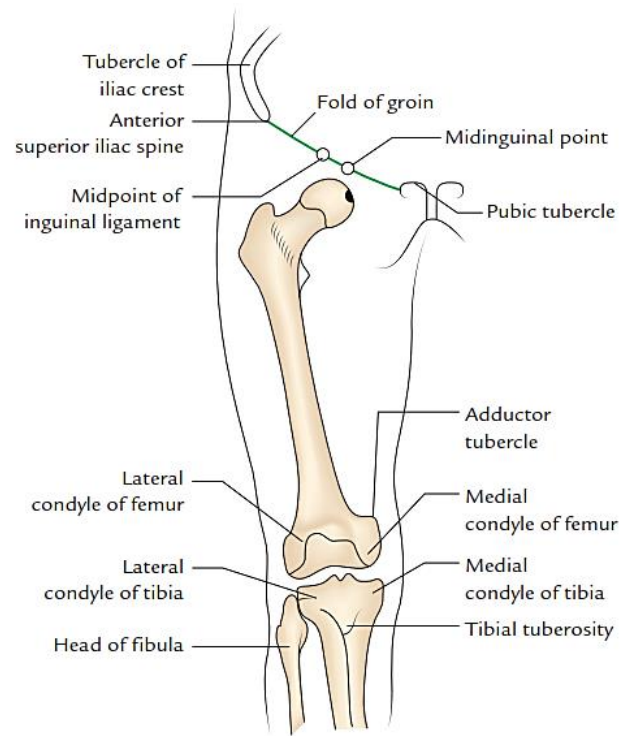
The distal end

This consists of the **medial and lateral epicondyles** at the end of the corresponding supracondylar lines. The medial epicondyle bears a small bony prominence called the **adductor tubercle**. Each epicondyle leads to a larger **condyle**. The medial and lateral condyles are separated posteriorly by the **intercondylar fossa**. Anteriorly, the 2 condyles are joined at the **intercondylar line**. The medial condyle is larger than the lateral one.



Surface landmarks:

- **Fold of groin** is a shallow curved groove extending from the pubic tubercle to the iliac spine. It corresponds to the underlying inguinal ligament and separates the anterior abdominal wall from the front of the thigh.
- **Anterior superior iliac spine** is palpated at the lateral end of the fold of the groin.
- **Pubic tubercle** is a small bony projection felt at the medial end of the fold of groin.
- **Greater trochanter** lies a hand's breadth below the tubercle of the iliac crest and forms a prominence in front of the hollow on the side of the hip.
- **Midinguinal point** is a point midway between the anterior superior iliac spine and the pubic symphysis.
- **Midpoint of inguinal ligament** is a point midway between the anterior superior iliac spine and the pubic tubercle.
- **Medial and lateral condyles of femur and tibia** form large bony masses on the medial and lateral sides of the knee, respectively. The most prominent points on the condyles are called epicondyles.
- **Fleshy swelling above the medial condyle of the femur** is formed by the lower part of the vastus medialis muscle.
- **Patella (knee cap)** is easily felt as a triangular bone in front of the knee. It is freely mobile when the knee is extended but becomes rigid when the knee is flexed.
- **Tibial tuberosity** is easily felt as a bony prominence on the front of the upper end of the tibia.
- **Ligamentum patellae** can be felt as a strong fibrous band stretching between patella and tibial tuberosity.
- **Adductor tubercle** can be felt just above the medial condyle of the femur and on deep pressure a cord-like tendon of adductor magnus is felt above the tubercle.



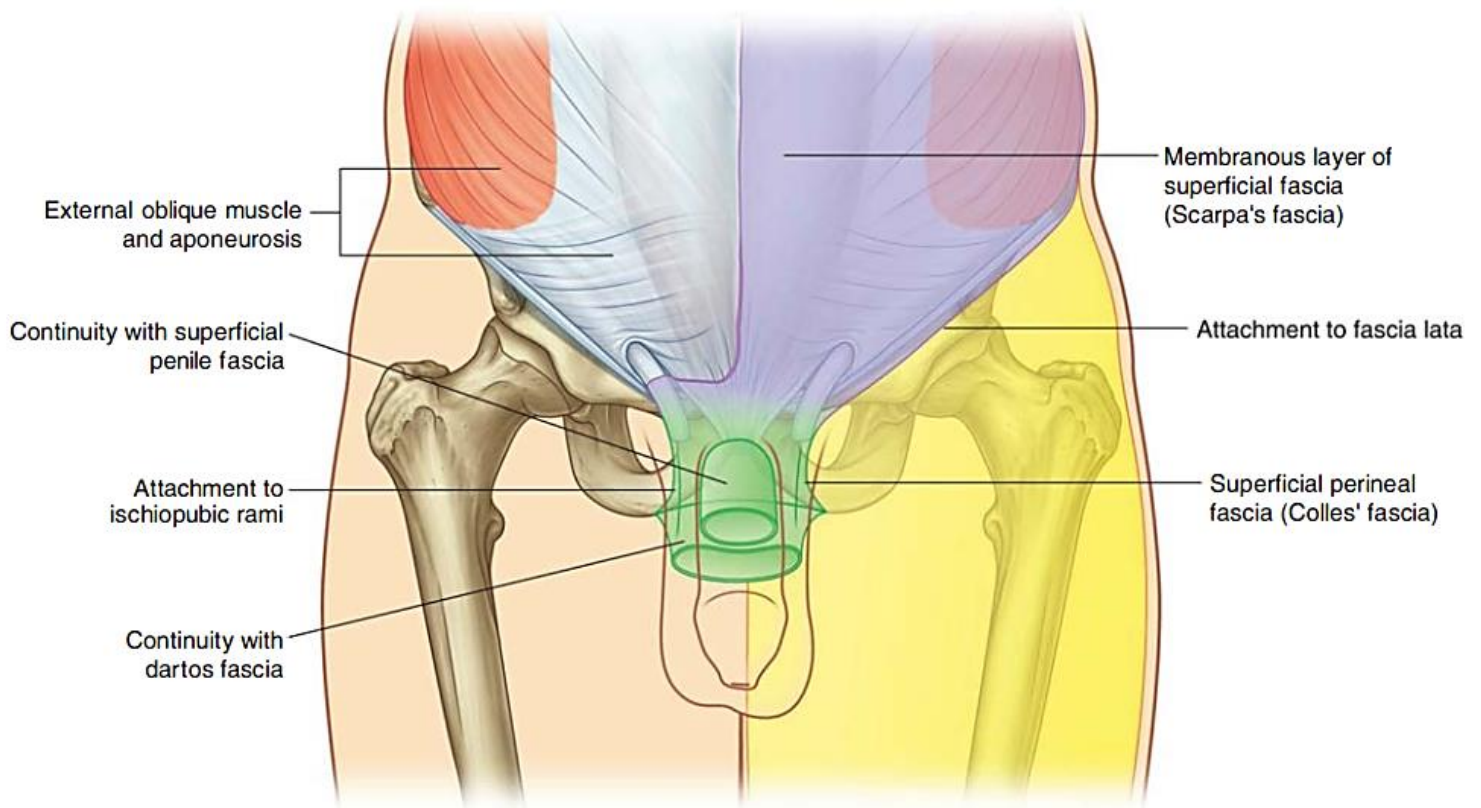
The superficial fascia

The superficial fascia of the front of the thigh is continuous with that of the anterior abdominal wall which is composed of 2 layers below the level of the umbilicus;

- A **superficial fatty layer** which is continuous from the fatty layer of the abdomen and extends over the whole length of the lower limb.
- A **deeper membranous layer** continues for a short distance only at the uppermost part of the thigh where it fuses with the deep fascia of the thigh (fascia lata) at a line lying a fingerbreadth below the inguinal ligament and extending medially to the pubic tubercle. The line of fusion passes from the pubic tubercle on the front of the body of the pubis, the sides of the pubic arch and backwards to the ischial tuberosity and the perineal body. Here, the membranous layer is called the **superficial perineal membrane (Colle's fascia)**. This fascia forms a tubular sheath for the penis or clitoris and separates the thigh from the submembranous area of the anterior abdominal wall and the perineum. Therefore, a fluid accumulation in that area of the abdominal wall or the perineum will not extend down the thigh because of the linear fusion.

The superficial fascia on the front of the thigh contains:

1. Cutaneous nerves.
2. Cutaneous arteries.
3. Termination of saphenous vein and its tributaries.
4. Superficial inguinal lymph nodes.



Cutaneous innervation of the front of thigh

The skin on the front of the thigh is supplied by seven cutaneous nerves which are derived from the lumbar plexus. These are 6 nerves in number as follows:

1. Ilioinguinal nerve.
2. Femoral branch of the genitofemoral nerve.
3. Cutaneous branch of the obturator nerve.
4. Intermediate cutaneous nerve of the thigh.
5. Medial cutaneous nerve of the thigh.
6. Lateral femoral cutaneous nerve (lateral femoral cutaneous nerve).

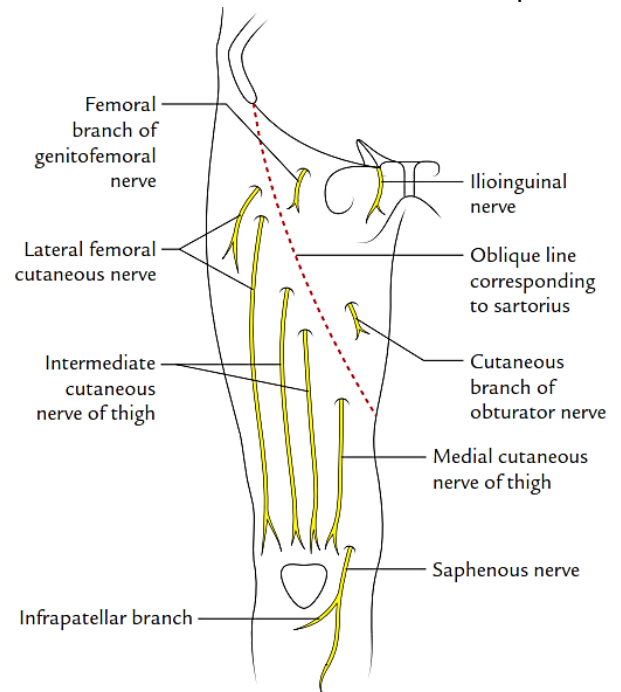
Above the line of sartorius

The ilioinguinal nerve (L1) emerges through the superficial inguinal ring and supplies the skin at the root of the penis, and the anterior one-third of the scrotum in male; and mons pubis and anterior one-third of labium majus in female; and the skin of the upper medial aspect of the thigh.

The femoral branch of the genitofemoral nerve (L1, L2) pierces the femoral sheath and the overlying deep fascia 2 cm below the midinguinal point, and supplies the skin over the femoral triangle

The **cutaneous branch of the obturator nerve** (L2, L3) supplies the skin of the lower anteromedial side above the line of sartorius.

The intermediate and medial cutaneous nerves of the thigh from the femoral nerve supply the anterior and anteromedial sides from the line of sartorius to the knee.

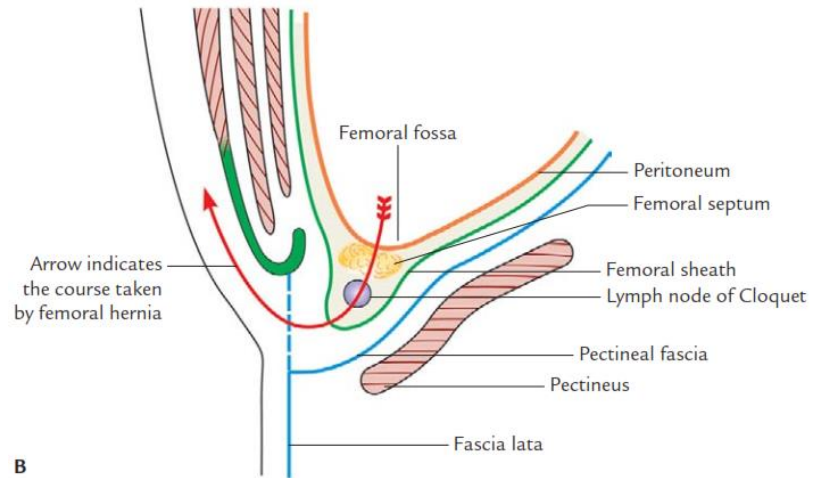


The lateral cutaneous nerve of the thigh (L2, L3) It enters the thigh by passing behind or through the lateral end of the inguinal ligament, a centimeter medial to the anterior superior iliac spine, and divides into anterior and posterior branches. It supplies the skin on the anterolateral side of the upper thigh.

Clinical correlation: The lateral cutaneous nerve of the thigh is sometimes compressed as it passes through the inguinal ligament, causing pain and paresthesia (altered sensations) in the upper lateral aspect of the thigh leading to a clinical condition called '**meralgia paresthetica**'. The surgical treatment of this condition requires division of the inguinal ligament and releasing nerve from the compression.

The inguinal ligament

The inguinal ligament represents the posteriorly curved, thickened free lower border of the aponeurosis of the external oblique muscle of the anterior abdominal wall. It extends from the anterior superior iliac spine to the pubic tubercle. Just lateral to the pubic tubercle, the deep surface of the inguinal ligament extends posteriorly to be attached to the pecten pubis as the triangular lacunar ligament. The apex of the lacunar ligament is attached to the pubic tubercle while its base forms a sharp free crescentic margin. The strong deep fascia of the thigh (fascia lata) attaches to the inguinal ligament and pulls it downwards and is therefore responsible for its downward curvature.



The deep fascia (fascia lata)

The deep fascia of the thigh is very strong and envelops the thigh like a sleeve. It is called fascia lata because it encloses a wide area of the thigh (Latin Latus = broad). Its attachments are as follows:

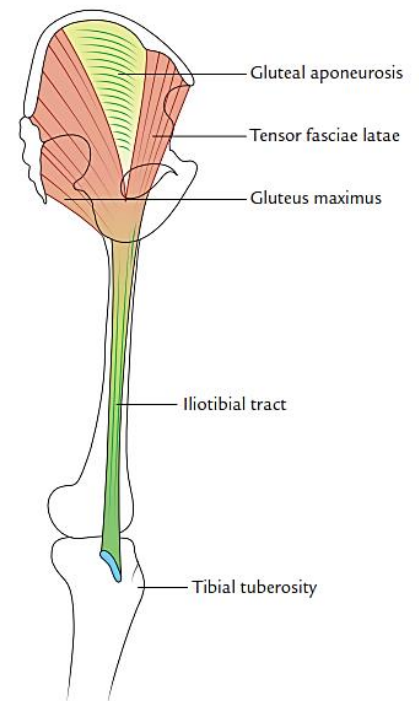
1. Superiorly, on the front of the thigh, it is attached to the anterior superior iliac spine, inguinal ligament, and pubic tubercle. Laterally it is attached to the iliac crest; posteriorly (through the gluteal fascia) to the sacrum, coccyx, and sacrotuberous ligament; and medially it is attached to the pubis, pubic arch, and ischial tuberosity.
2. Inferiorly on the front and sides of the knee, it is attached to subcutaneous bony prominences and the capsule of the knee joint.

Modifications of fascia lata

The deep fascia of the thigh presents two modifications: iliotibial tract and saphenous opening.

Iliotibial tract

The tensor fasciae latae & gluteus maximus muscles, working through their attachments to the iliotibial tract, hold the leg in extension once other muscles have extended the leg at the knee joint, hence it is used constantly during walking and running. The iliotibial tract and its two associated muscles also stabilize the hip joint by preventing lateral displacement of the proximal end of the femur away from the acetabulum. On leaning forward with slightly flexed



knees the iliotibial tract is the main support of the knee against gravity and prevents the individuals from falling forward.

Saphenous opening

This is an oval opening in the fascia lata in the upper medial part of the front of the thigh. The center of the opening is about 4 cm below and lateral to the pubic tubercle. Its vertical length measures about 3–4 cm. The opening is bounded inferolaterally by a sharp crescentic (falciform) margin. It is formed by the superficial stratum of the fascia lata, which lies in front of the femoral sheath. The medial margin of the opening is illdefined and formed by the deep stratum which lies at a deeper level and becomes continuous with the fascia overlying the pectineus (pectineal fascia). It lies behind the femoral sheath.

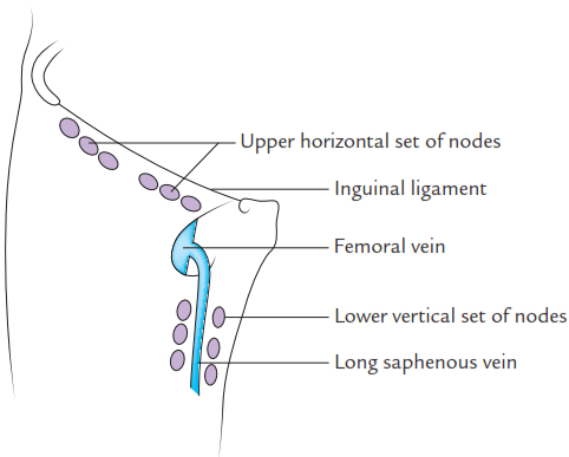
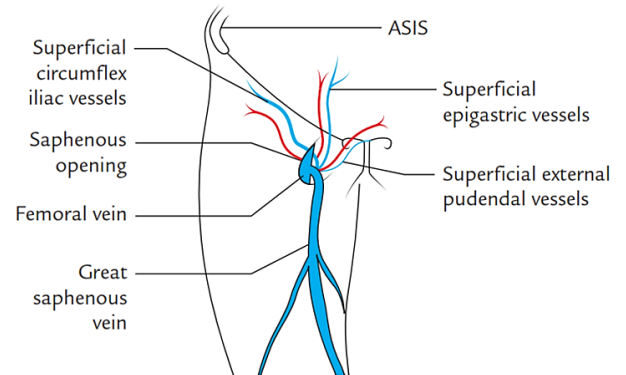
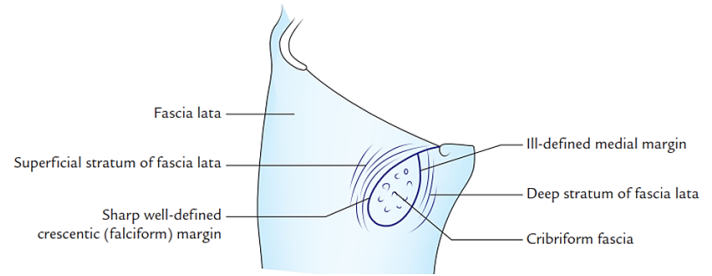
The saphenous opening is closed by the membrane of areolar tissue the – cribriform fascia which is pierced by number of structures making it sieve-like, hence the name cribriform.

Structures that pass through the cribriform fascia **into** the saphenous opening are;

- 1- The **great saphenous vein** draining into the femoral vein.
- 2- **Efferent lymph vessels** from the superficial to the deep inguinal lymph nodes.

Structures that pass through the cribriform fascia **out of** the saphenous opening are the three superficial branches of the femoral artery;

- 1- The **superficial external pudendal artery**.
- 2- The **superficial epigastric artery**.
- 3- The **superficial circumflex iliac artery**



The inguinal lymph nodes

These are divided into superficial and deep groups.

The superficial inguinal lymph nodes

These nodes lie in the superficial fascia and have a T-shaped arrangement with a horizontal group parallel to and below the inguinal ligament, and a vertical group around the upper part of the great saphenous vein. The superficial inguinal lymph nodes drain lymph from the following areas;

- The trunk below the level of the umbilicus including the perineum, the anal canal, the lower vagina and urethra and the external genitalia and scrotum with the exception of the testes (drained to the lumbar nodes) and glans penis (drained to the deep

inguinal nodes).

- The fundus and body of the uterus through vessels along the round ligament.
- The skin and fascia of the whole lower limb except the heel and the lateral side of the foot which drain to the popliteal nodes.
- The efferent lymph vessels of the superficial inguinal lymph nodes pass through the cribriform fascia to drain lymph to the deep inguinal lymph nodes.

The deep inguinal lymph nodes

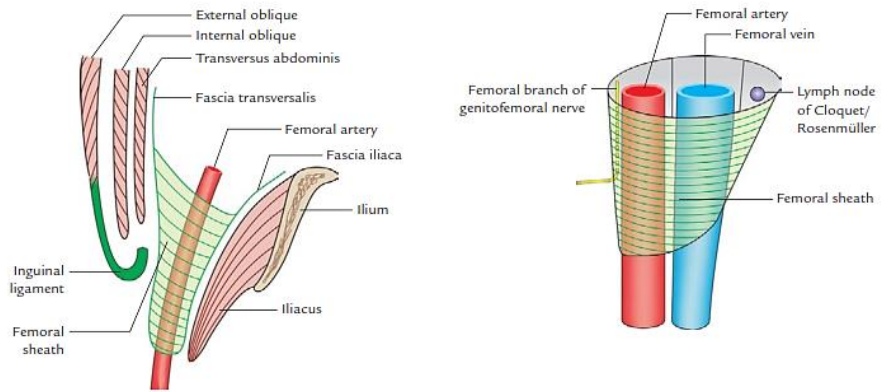
These nodes lie vertically in the femoral triangle along the medial side of the femoral vein. They receive lymph from;

- The superficial lymph nodes.
- The glans penis.
- The popliteal nodes.
- The deep structures of the lower limb.

The efferent lymph vessels of the deep nodes pass along the femoral vessels towards the external iliac nodes in the pelvis.

Femoral sheath

It is a funnel-shaped fascial sheath enclosing upper 3.5-4 cm of femoral vessels. The base of the sheath is directed upward toward the abdominal cavity and apex merges with the tunica adventitia of the femoral vessels. The anterior wall of the femoral sheath is formed by the downward prolongation of the **fascia transversalis** and the posterior wall by the downward prolongation of the **iliacus fascia**. The femoral sheath is not symmetrical. Its lateral wall is vertical whereas its medial wall is oblique being directed downward and laterally.



The interior of the femoral sheath is divided into three compartments by two anteroposterior fibrous septa.

- Lateral compartment lodges the femoral artery and genital branch of the genitofemoral nerve.
- Middle compartment contains the femoral vein.
- Medial compartment is relatively empty and called femoral canal. It contains lymph node of Cloquet and fibrofatty tissue.

Femoral canal

It is a short fascial tube (medial compartment of femoral sheath) which diminishes rapidly in width from above downward and is closed inferiorly by the fusion of its walls. The upper end of the femoral canal, which opens into the abdominal cavity is called **femoral ring**. A fatty areolar tissue called femoral septum normally closes it. Cloquet's node is a lymph node situated in the femoral canal. The canal provides a dead space for the expansion of femoral vein during increased venous return.

BOUNDARIES

Anterior: Inguinal ligament

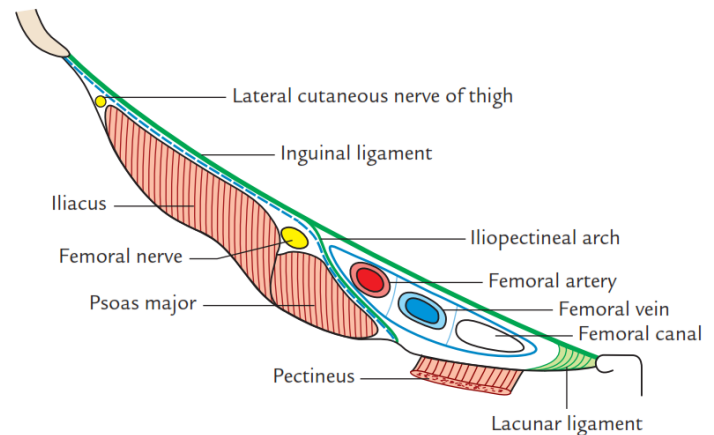
Medial: Sharp edge of the lacunar ligament

Posterior: Pecten pubis

Lateral: Femoral vein

Below the inguinal ligament, the canal lies posterior to the saphenous opening and thin cribriform fascia, and anterior to the fascia covering the pectineus muscle.

Clinical correlation: *Femoral hernia: The protrusion of abdominal contents (a loop of intestine) through the femoral canal is called femoral hernia. The femoral ring is the site of potential weakness of the groin when the femoral ring is enlarged due to the abdominal distention with weakness of abdominal muscles, e.g., pregnancy. Any condition, which raises the intraabdominal pressure, e.g., repeated forceful coughing or straining forces the loop of intestine into the*



femoral ring, it carries with it the peritoneal covering of the abdominal opening of the canal in front of it. This forms the hernia sac, which descends in the femoral canal posterior to the weak cribriform fascia and bulges forward through it into the superficial fascia of the thigh close to the saphenous vein. If hernial sac continues to enlarge, it expands superolaterally in the superficial fascia. Consequently, the entire hernia becomes U-shaped. The femoral hernia presents as a globular swelling in groin inferolateral to the pubic tubercle below the inguinal ligament. The femoral hernia is common in female because the femoral ring is larger due to greater width of the pelvis.